

Activities on subseasonal prediction at APEC Climate Center

Hae-Jeong Kim, Seon-Tae Kim and Hyung-Jin Kim
APEC Climate Center

In collaboration with WGNE/MJO TF
and University of Hawaii



Overview of APCC Mission



APCC aims at promoting prosperity in the APEC region through the *enhancement* of economic opportunities, the reduction of economic loss and the protection of life and property through *producing* high quality climate prediction and *delivering* relevant climate information to the decision makers.

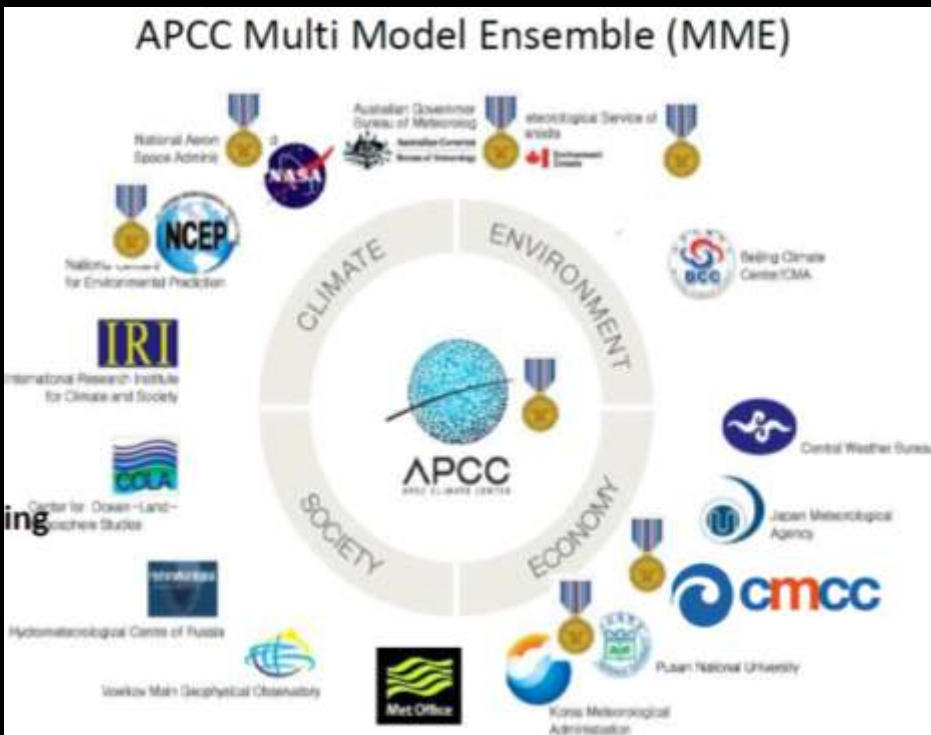
Operational MME – Seasonal Forecast

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Providing climate information services based on a multi-model ensemble prediction system

Multi-Institutional Cooperation

APCC Multi Model Ensemble (MME)

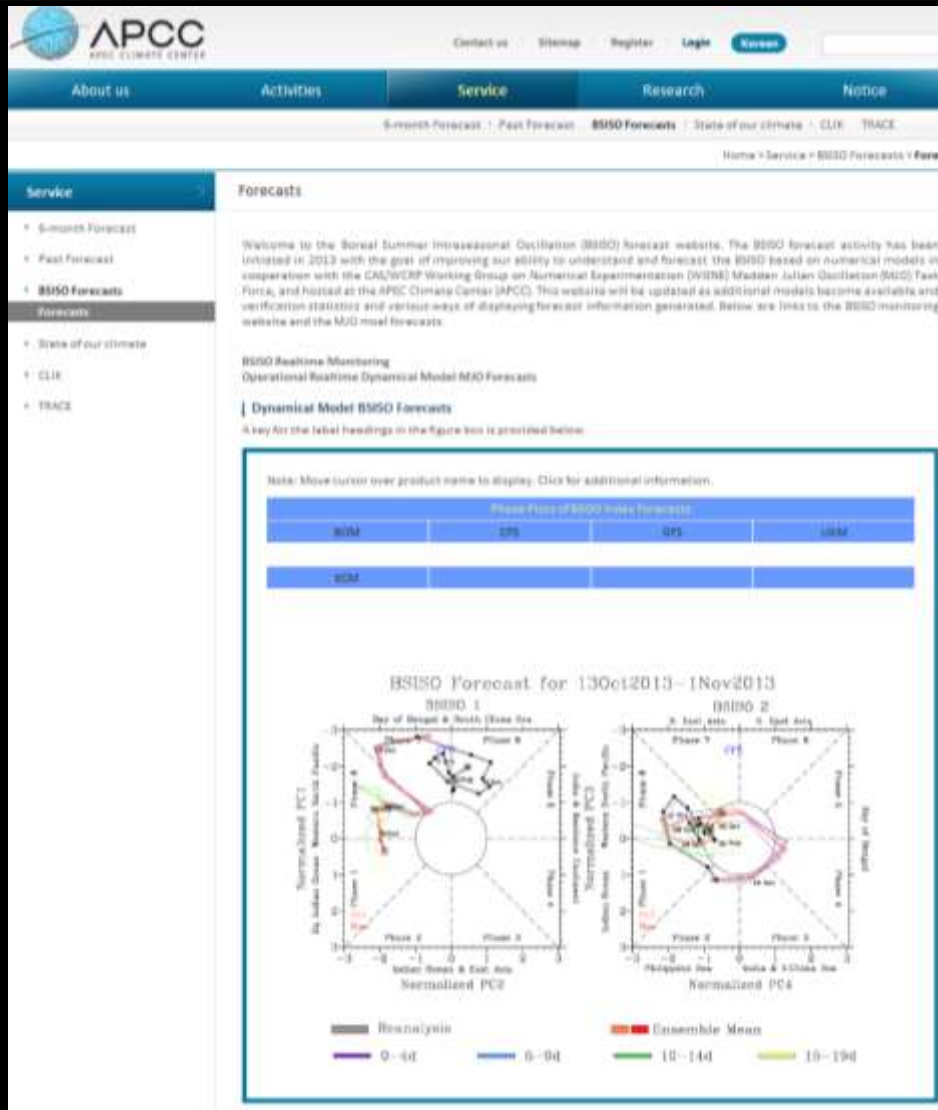


16 organizations in 10 countries

APCC launched monthly 6-month prediction service in order to better prepare for climate-related hazards in a timely manner

: 7 organizations in 5 countries

Climate service's expansion into subseasonal forecast (from July 2013)



Scaled up the climate information services by providing BSISO forecasts in cooperation with WGNE/MJO Task Force

Applied to the Lee et al. (2013) BSISO index

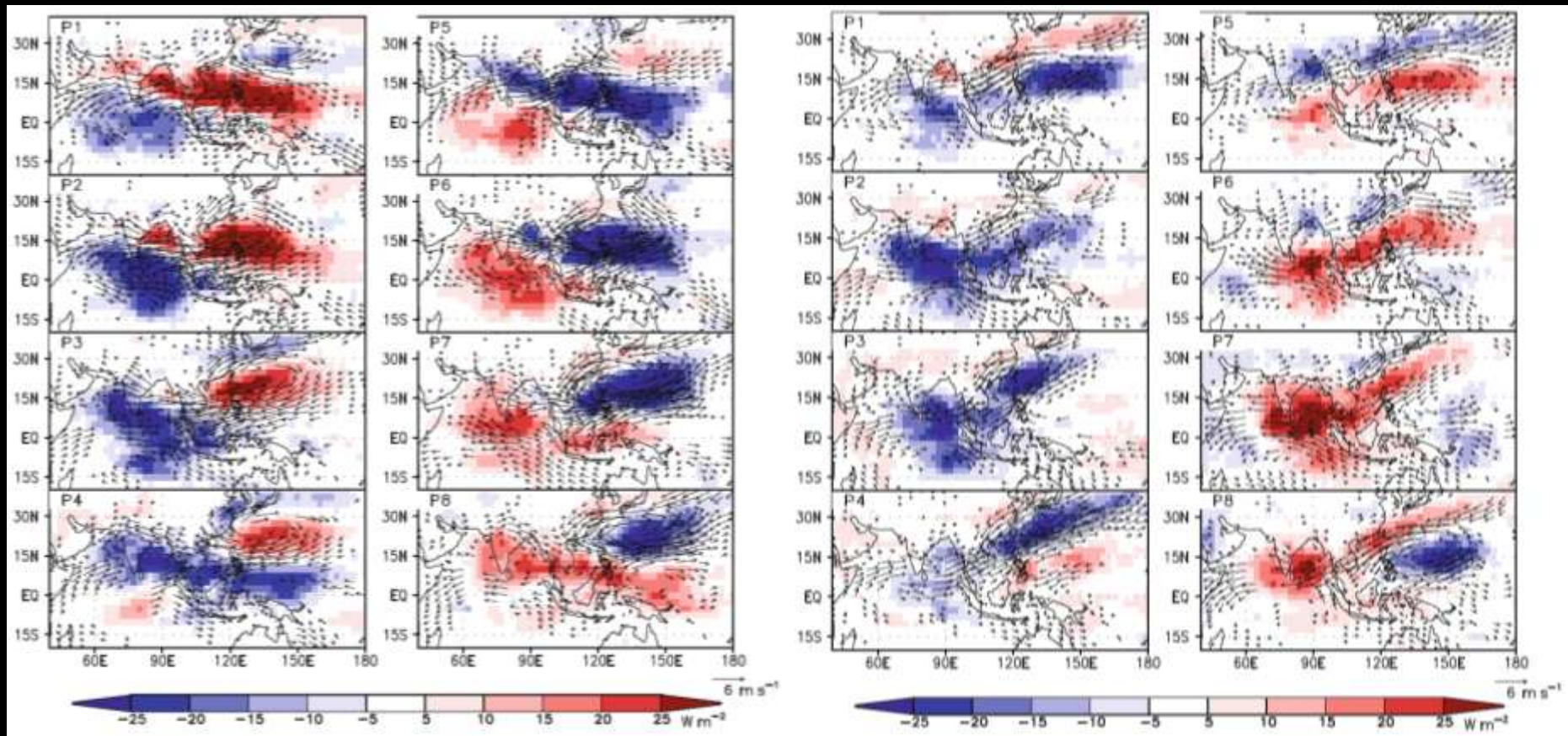
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BSISO 1

The canonical northward propagating component

BSISO 2

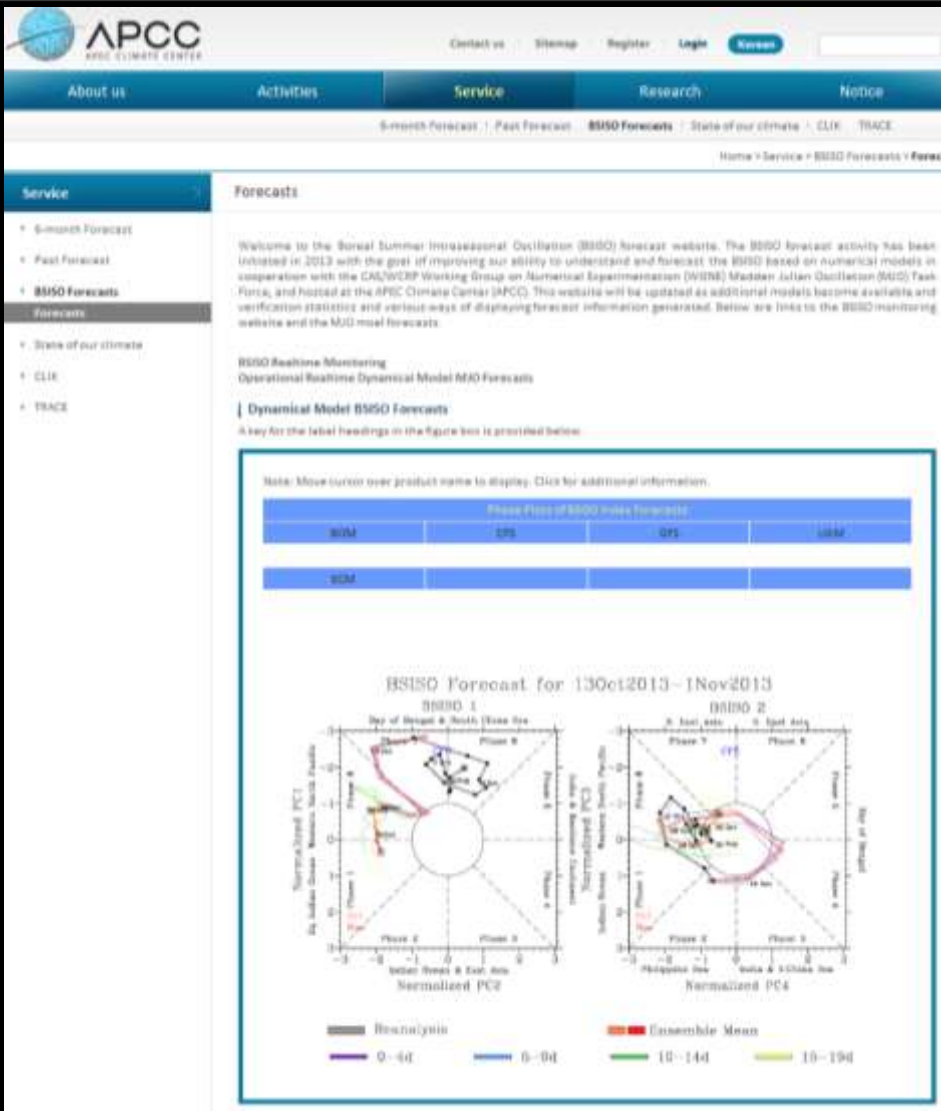
The ASM pre-monsoon and onset component



Lee, J.-Y., B. Wang, M. C. Wheeler, X. Fu, D.E. Waliser, and I.-S. Kang, 2013: Real-time multivariate indices for the boreal summer intraseasonal oscillation over the Asian summer monsoon region. *Clim. Dyn.*, 40, 493-509.

Dissemination

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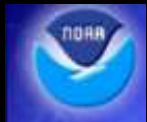






The final product is a *phase diagram* displaying BSISO1 and BSISO2 values , including the values for *the recent 15 days and forecasts for the next 20 days*.

The BSISO forecast is *updated every day* with the latest information and is available from May to October *at APCC webpage* (<http://www.apcc21.org>).

Participating models

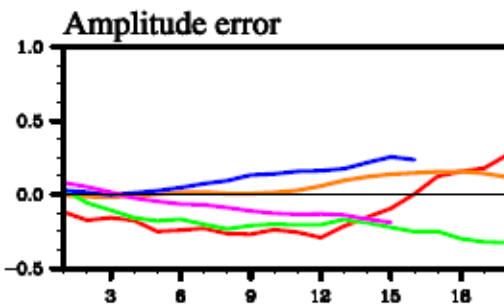
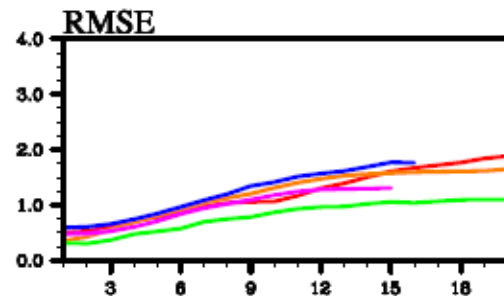
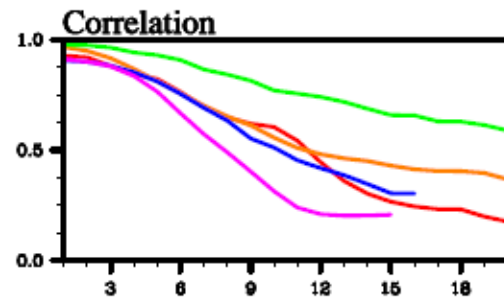
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Institute	Model	Ensemble Size	Forecast Period	Update frequency	Resolution
 NCEP	Climate Forecast System	4	40 days	Once a day	T126 L64
	Global Forecast System	1	16 days	Once a day	T574, T190 L64
 Australia	POAMA 2.4 multi-week model	33	40 days	Twice per week	T47 L17
 ECMWF	ECMWF Ensemble Prediction System	51	32 days	Twice per week	T639, T319 L62
 UK Met Office	MOGREPS-15	24	15 days	Once a day	60km L70
 Taiwan CWB	CWB EPS T119	6	40 days	Every 5 days	T119 L30

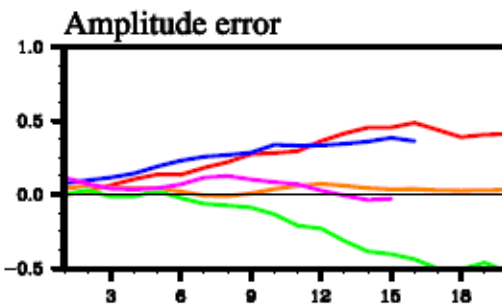
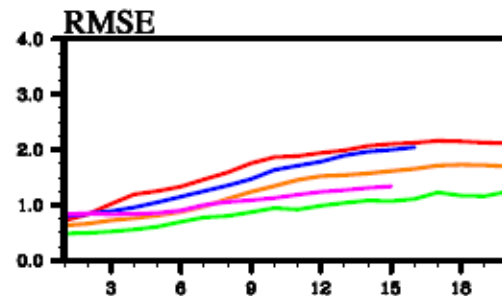
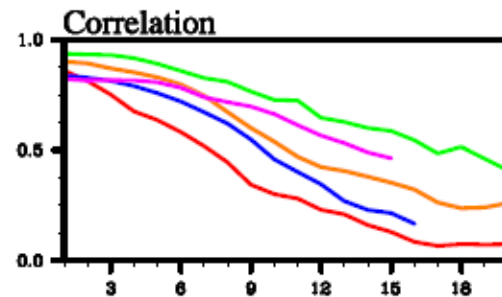
Real-time verification

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BSISO 1



BSISO 2



BOM CFS ECM GFS UKM

Assessment of real-time forecast skill for the BSISO1 and BSISO2 during May-October for 2013-2014

BSISO indices are generally predictable from 1 week to over 20 days forecast lead time.



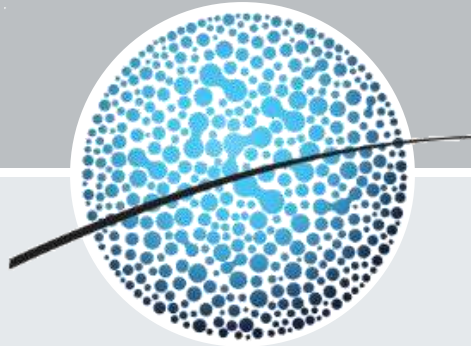
Challenge to BSISO MME forecast

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With advance knowledge of the forecast characteristics of each model, we can ensure more reliable multi-model ensemble forecasts of the BSISO in operational uses.

The models' performance in predicting the BSISO varies with the initial amplitude and phase of BSISO, consequently, it is an advantage to use a multi-model ensemble forecast.

Development of MME forecast system on BSISO (2015-16)



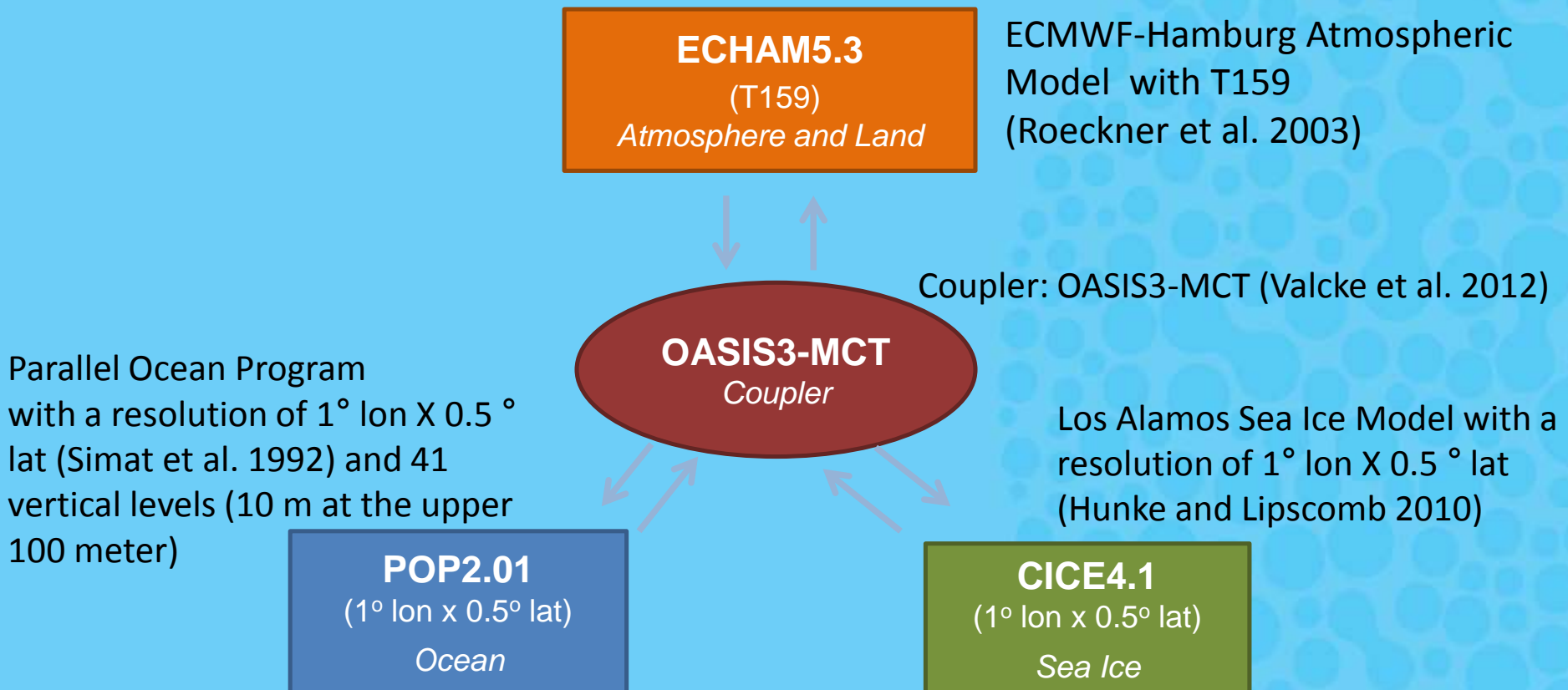
Development of Coupled Climate Model (In progress)

Seamless Coupled Prediction System

- Seamless prediction of weather and climate is a major theme of the World Climate Research Program (WCRP) strategic framework called Coordinated Observation and Prediction of the Earth System (COPES) (WCRP COPES, 2005).
- A fundamental principle of seamless prediction is that the Earth system exhibits a wide range of dynamical, physical, biological, and chemical interactions involving spatial and temporal variability continuously spanning all weather/climate scales.
- It has been demonstrated that fully coupled general circulation model is an ultimate tool for subseasonal to seasonal climate prediction.
- Seamless prediction in APCC will be a big challenge but have a significant contribution to many National Hydrometeorological Services within the Asia-Pacific Economic Cooperation (APEC).

APCC SCoPS (Seamless Coupled Prediction System)

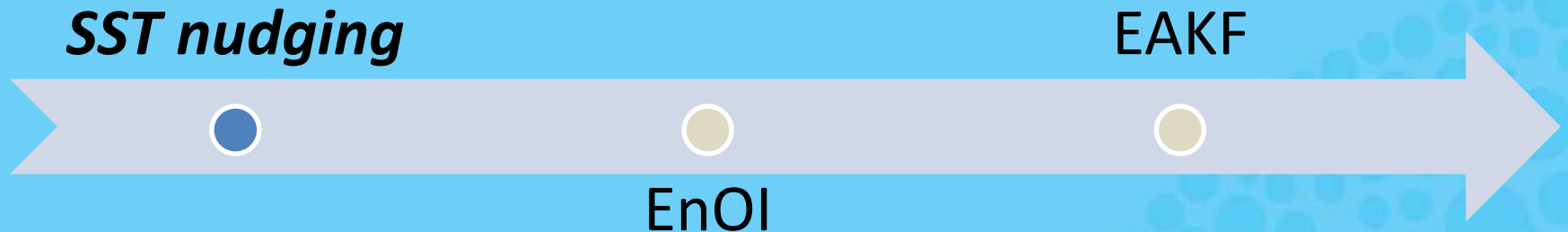
- Developed together with the modeling group in the University of Hawaii at Manoa



Atmospheric Initialization

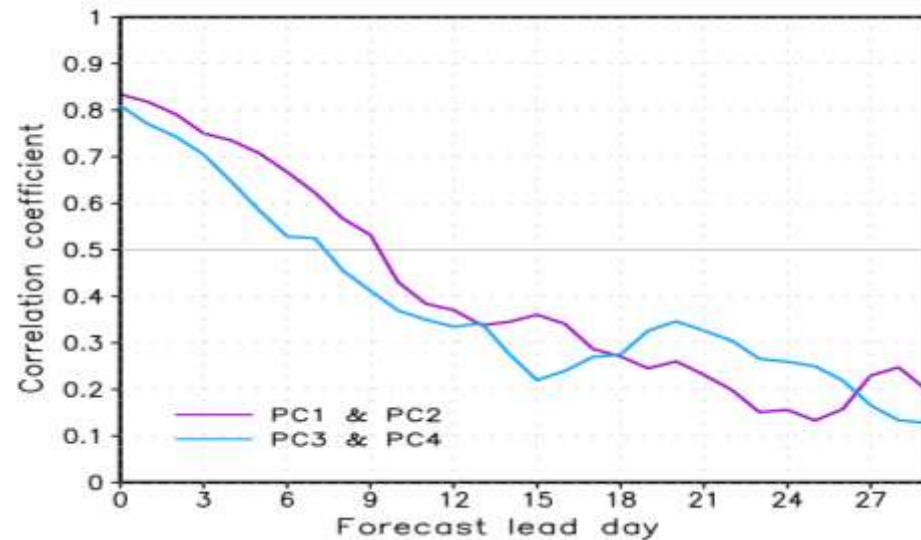
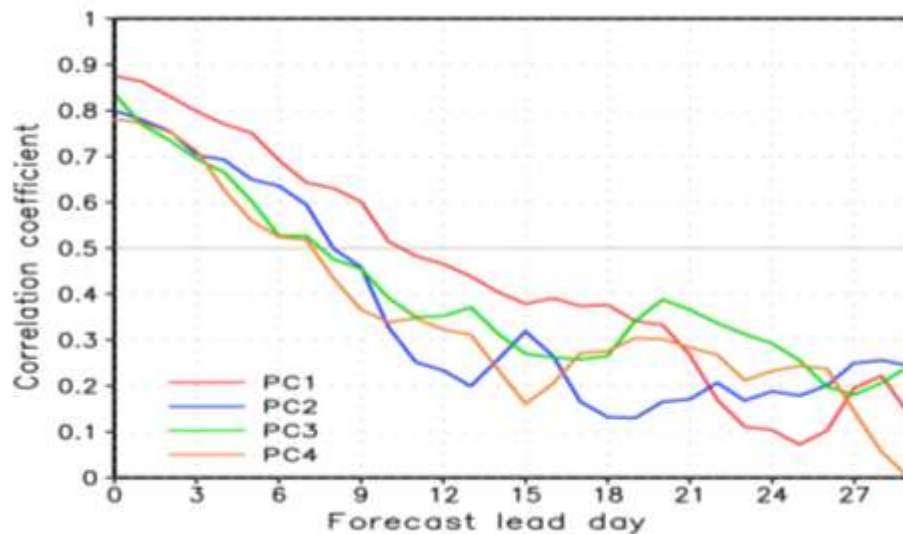
- **High resolution 3-D nudging scheme**
 - NCEP FNL 1x1-degree 6-hourly analysis
 - Three steps for perturbed initial conditions for the ensemble hindcasts and forecasts
 - 1) generation of model-compatible data set from FNL data
 - 2) nudging the model-compatible 3-D data into the model
 - 3) generation of perturbed ensemble initial conditions

Ocean Initialization



- Atmospheric 3-D nudging and oceanic SST nudging
- Targeted recent 10 year (2004-2013) boreal summer (MJJJA) initialized once every 10 days
- Twelve forecasts were carried out each year initialized on May 01st, 11th, 21st; June 01st, 11th, 21st; July 01st, 11th, 21st; and August 01st, 11th, 21st.
- Each forecast has been executed with 5 ensembles.

BSISO



Correlation coefficients of hindcast PCs with observed PCs (left panel)
Bivariate correlation coefficients of PC1&PC2 (BSISO1) and PC3&PC4 (BSISO2) (right panel)

- The skill of the BSISO1 is slightly more than 9 days, while the BSISO2 is about one week. These skills are not impressive but comparable with previous results.

Ocean Initialization

SST nudging

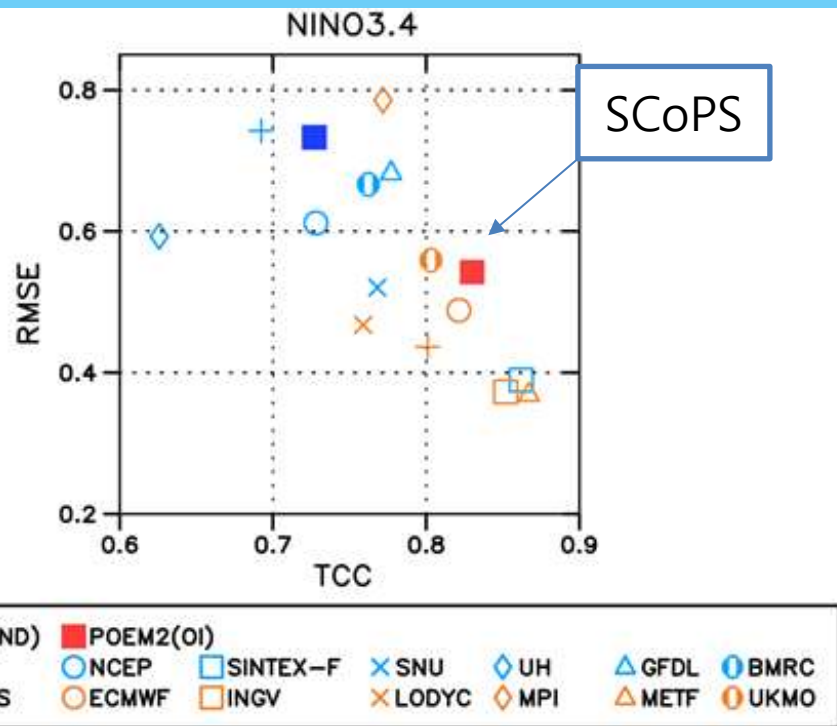
EAKF

EnOI (Ensemble optimum interpolation)

- In a similar way as Ensemble Adjustment Kalman Filter
- Assimilation frequency : daily
- Attempted to use real ocean profile data
 - NOAA optimum interpolation SST data
 - Mechanical Bathythermograph data (MBT)
 - Expendable bathythermograph data (XBT)
 - Profiling float data (PFL)
 - Ocean station data (OSD)
 - The conductivity-temperature-depth data (CTD)
 - Drifting buoy data (DRB) and Moored buoy data (MRB)

Nudging and EnOI

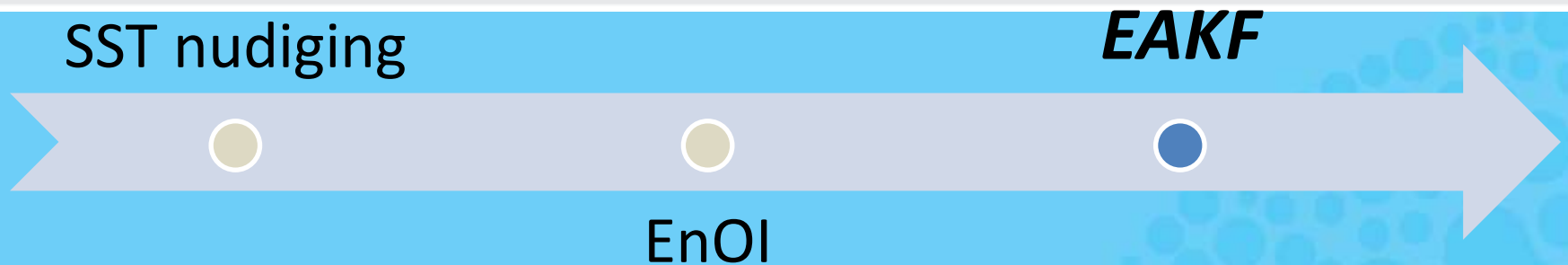
Temporal correlation coefficients and root mean square error skill for Niño3.4 of CliPAS and DEMETER models.



- 31 year (1982-2012) data assimilation run and 30 year hindcast run (1983-2012)
- Starts from 7th-11th of May and forecast for eight months.

Hindcast skill of our EnOI also has a very good standing among the current seasonal forecast systems.

Ocean Initialization



Ensemble Adjustment Kalman Filter (EAKF)

- Zhang et al. (2007)
- The family of ensemble square root filters (Tippett et al. 2003)
- Widely used by operational centers (e.g., GFDL, NCAR)
- Now we are doing test runs with the EAKF implemented into SCoPS!!

We are doing well!!

- **We are doing *30 year* assimilation and hindcast runs (*at least 10 ensemble*) with *atmospheric 3-D nudging* and *oceanic EAKF initializations*.**
- **This year we will perform several test runs and *next year* we hope this SCOPS model is being run for an *operational seasonal-to-interannual forecast*.**



Thank you